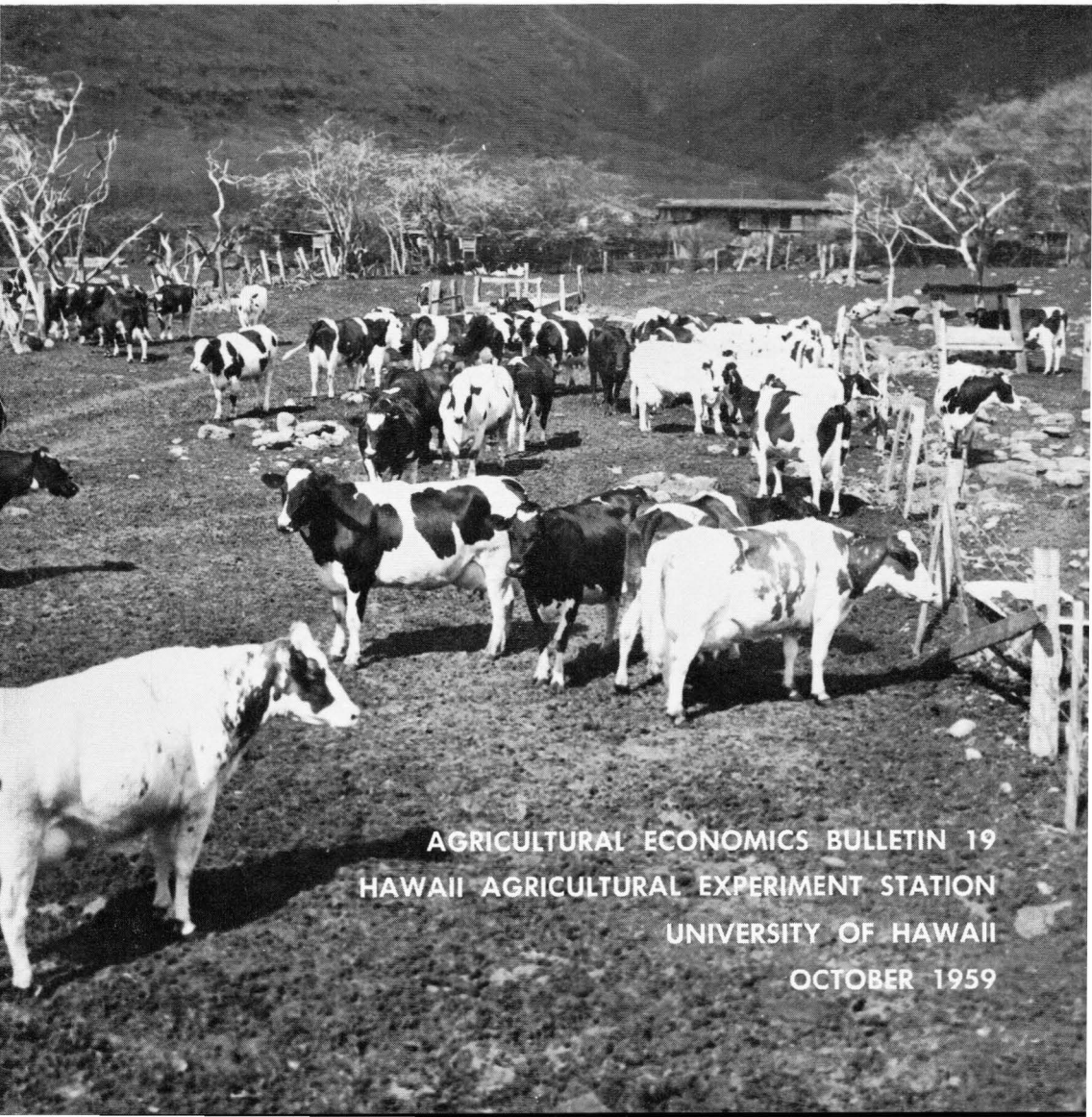
ECONOMICS OF MARKET MILK PRODUCTION ON OAHU— THE HONOLULU MILKSHED

by J. A. Mollett



AGRICULTURAL ECONOMICS BULLETIN 19
HAWAII AGRICULTURAL EXPERIMENT STATION
UNIVERSITY OF HAWAII
OCTOBER 1959

Second printing, December 1961

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ACKNOWLEDGMENTS

The author wishes to express appreciation for the valuable services given by Dr. James H. Koshi, Area Specialist in Dairy Science in the Hawaii Agricultural Extension Service, in arranging interviews with dairymen.

The assistance of Oahu dairymen in readily making available their financial results and production records is also gratefully acknowledged. Other agencies which assisted in providing data used in this survey—feed companies, milk distributors, cattle importers, shipping companies, and the Hawaii Cooperative Crop and Livestock Reporting Service—also deserve credit for their help. The author is also indebted to his colleagues in the College of Agriculture for constructive suggestions which improved this manuscript.

The photographs were taken by Dr. Koshi; those showing dairy cattle being unloaded at Honolulu docks were taken by kind permission of Matson Navigation Company, Castle and Cooke Terminals, Ltd., and Hawaiian Textron, Inc. The charts were prepared by Robert B. Knaggs.

COVER PHOTO: A TYPICAL DAIRY SCENE ON OAHU.

SUMMARY

A considerable expansion took place in Oahu's milk industry in the 11-year period, 1948–58. The number of dairies rose from 39 to 60, annual milk production increased from 24 to 46 million quarts, and numbers of cows went up from 6,800 in 1948 to 10,900 in 1958. Average daily yield per cow also increased, from 9.7 to 11.9 quarts—a rise of almost 25 percent.

Annual per capita consumption of fresh milk and cream in the Honolulu metropolitan area increased from about 59 to about 94 quarts between 1948 and 1958. The 1958 level of fresh milk consumption in Honolulu at 94 quarts was still only about two-thirds the corresponding level for the mainland United States at 142 quarts.

The rise in Oahu milk production between 1948 and 1958 led to considerable changes in the quantity and composition of inputs, or supplies used. With one important exception—dairy cows—extra inputs have been largely imported rather than of local origin.

Milk marketing in Honolulu is similar in its most important respects to many city milk markets on the Mainland. The market is allocated by the two major distributors between the individual dairies on the basis of quotas. Both quota systems feature the "classified price" plan which provides different prices to be paid for milk according to use and the "base and surplus" plan under which each farmer has a basic quota.

A comparison of average retail and farm prices of milk between 1948 and 1958 on the Mainland and in the Honolulu milkshed shows that the relatively high retail price of Honolulu milk is attributable to high production costs rather than to costs of distribution. The distributors' margins (the difference between retail and farm price) in the two areas during the 11-year period were very similar, at about 11 cents per quart. Production costs presented a different picture—about 17 cents per quart locally and about 9 cents per quart on the Mainland.

Earnings in Oahu dairying have been relatively good. The steady movement of dairies from the vicinity of Honolulu to more rural areas has led to lower earnings for some dairies. It has required high capital expenditure for the purchase of land, buildings, and equipment without any compensating increase in quota or price.

A survey was carried out on 42 of the 57 commercial dairies on Oahu in November and December, 1958, to determine the cost of producing market milk. The average cost of producing 1 quart of milk on these 42 dairies in the 12-month period ending September 30, 1958, was 17.31 cents. The average price received per quart was 17.96 cents. Average net income—the difference between these two amounts—was 0.65 cent per quart. A wide range and distribution existed between one dairy and another in production costs, prices received, and net income (on a per quart basis).

Average total investment per herd and per cow amounted to $108,051 and $642, respectively. Investment on individual Oahu dairies varied considerably, depending on such factors as whether land was leased or owned, the age structure of equipment, and the length of occupancy of the dairy (newcomers to dairying having the highest total investment per cow). Investment was based on the depreciated value of livestock and equipment. Average total investment would have been substantially higher if it had been based on current replacement cost.

An attempt was made to explain the causes of the wide variation in net income per cow between individual dairies. A fairly close relationship was found to exist between production and net income per cow.

Economy in the use of feed has an important bearing on net income of a dairy. It was shown that feed costs per unit varied considerably from one dairy to another. At the 8,000-pound level of production, for example, average annual feed costs varied from $237 to $350 per cow and at the 9,000-pound level from $280 to $404 per cow. Such wide differences appear to indicate that cows are wastefully fed on some Oahu dairies.

Labor is also wastefully used on many Oahu dairies. Labor costs per quart varied from less than 2 cents to more than 3½ cents. A considerable variation existed in the efficiency of operating three different types of milking systems. Farmers using the pipeline system, for example, milked from 14 to 27 cows per man-hour and had an output of from 218 pounds to 500 pounds of milk for that effort. Those using the parlor system of milking had corresponding performances of 16 to 28 cows milked and 277 to 570 pounds of milk per man-hour. The corresponding results with the bucket-type machine were from 10 to 18 cows milked and from 175 to 358 pounds of milk per man-hour.

Large differences existed in the amount of net stock expense per unit between individual dairies—from less than $50 per cow to more than $150 per cow. Some part of these differences was undoubtedly attributable to management. Yet this expense item tends to remain an unknown quantity—a risk of dairy farming.

Average price received for milk was shown to be closely related to net income per cow. Results of 18 dairies in three groups of 6, based on an ascending average butterfat content of milk sales, were analyzed. No significant difference existed in production costs, averaging about 16½ cents per quart for all three groups. However, as the milk became higher in butterfat content from one group of dairies to the next, the average price received increased from 17 cents to 18 cents to slightly above 19 cents per quart, leading to striking differences in net income among the three groups.

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INTRODUCTION

This report is the third in a series dealing with various economic aspects of market milk production on the island of Oahu, the milkshed for the Honolulu metropolitan area. The first report in this series dealt with the economics of grass use on Oahu dairies.[1] It was based on a survey carried out in 1956. That report also gave some additional information about the location, land tenure, feeding practices, and land use of Oahu dairies. The second report in this series presented preliminary findings of a survey carried out in 1958 to determine the cost of producing milk on Oahu.[2]

This report has two major objectives: (1) to examine recent trends and characteristics of Oahu dairying—output, inputs, prices, and marketing; and (2) to analyze the causes of the wide range in cost, price received, and net income per unit of output among dairies on the island, which the 1958 survey revealed. The material in this report conveniently falls under two headings—descriptive and analytical. Descriptive data relating to trends and other features of Oahu dairying are dealt with first.

RECENT CHANGES IN THE MILK INDUSTRY OF OAHU

Number and Size of Dairies

The number of dairies on Oahu increased from 39 to 60 between 1948 and 1958. The average size for a dairy, judged by number of cows in the milking herd, remained almost unchanged during this 11 year period—176 in 1948 compared with 182 in 1958. However, this statistic does not adequately express the change which took place in the size-distribution of these dairies. Relatively "small" dairies with around 50 cows remained close to the 1948 level (7 in 1948; 6 in 1958). Large dairies with more than 300 cows increased from 3 to 6, while the group with between 150 and 300 cows rose from 13 to 19. The remaining dairies with between 50 and 150 cows (average milking herd, about 100) had the greatest absolute increase—from 16 to 29.

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[1]Perry F. Philipp, James H. Koshi, and Robert L. Johnson, *Grass for Oahu Dairies—An Economic Study of Grass Harvesting and Distribution and Other Factors Related to Dairy Production*, Hawaii Agricultural Experiment Station, University of Hawaii College of Agriculture, in cooperation with the Agricultural Experiment Stations of the Western States, Bulletin 118, June, 1958, 79 pp.

[2]J. A. Mollett, *Cost of Producing Market Milk on Oahu—The Honolulu Milkshed—A Preliminary Report*, Hawaii Agricultural Experiment Station, Agricultural Economics Report 36, January, 1959, 12 pp.

The size distribution of the 57 commercial dairies on Oahu in 1958 (excluding three noncommercial dairies) is given in table 1, by average monthly milk sales.

TABLE 1. Distribution of commercial dairies,* by average monthly milk sales, Oahu, 1957–58

Average monthly milk sales	Number of dairies
Quarts	
20,000 or less	3
20,001– 30,000	12
30,001– 40,000	11
40,001– 50,000	8
50,001– 60,000	7
60,001– 70,000	2
70,001– 80,000	7
80,001–100,000	2
Over 100,000	5
Total	57

*Excluding three dairies run by institutions, and any dairy with less than 10 cows.

Output

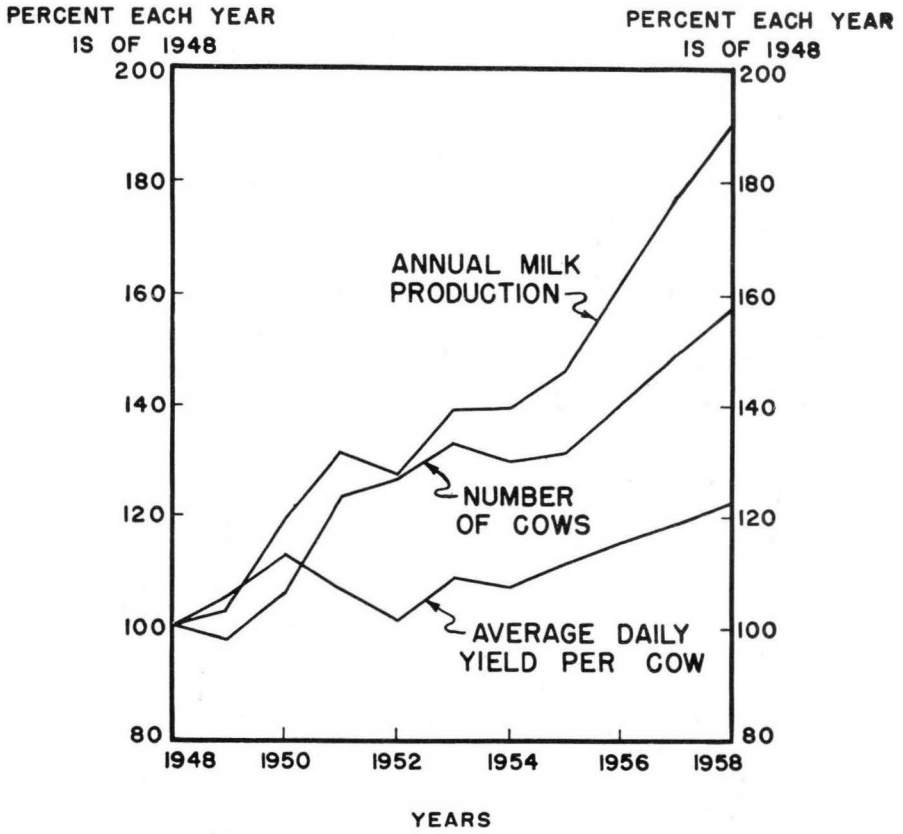
Annual production of market milk from Oahu dairies almost doubled between 1948 and 1958—from 24.4 million quarts to 46.4 million quarts. Figure 1 shows that this large increase in production stemmed from a rise in cow numbers of about 60 percent (about 6,800 in 1948; 10,900 in 1958) and in average daily yield of milk per cow of about 23 percent (about 9.7 quarts in 1948; 11.9 quarts in 1958).

The seasonal pattern of output has remained relatively stable during recent years. Milk produced on Oahu is almost all used as fresh milk and cream so the output pattern closely follows demand for these two commod ities. Undoubtedly influenced by Honolulu's equable climate, the seasonal demand for milk is fairly steady.

Two factors tend to disrupt this pattern of demand: movements of naval and military personnel to and away from naval and military bases, and school holidays. Sudden arrival or departure of relatively large numbers of troops or naval ships has a very marked effect on demand for fresh milk. Currently, military and naval personnel consume about 10 percent of total supplies of fresh milk and cream in the Honolulu area.

School holidays whether of a day, a week, or several months (as in summer) cause a sharp drop in consumption of fresh milk. It appears that children are quite willing to drink subsidized milk provided with their school lunches. Parents, however, are not, at present, willing to buy extra milk during school holidays to enable their children to maintain the milk drinking habit associated with school.

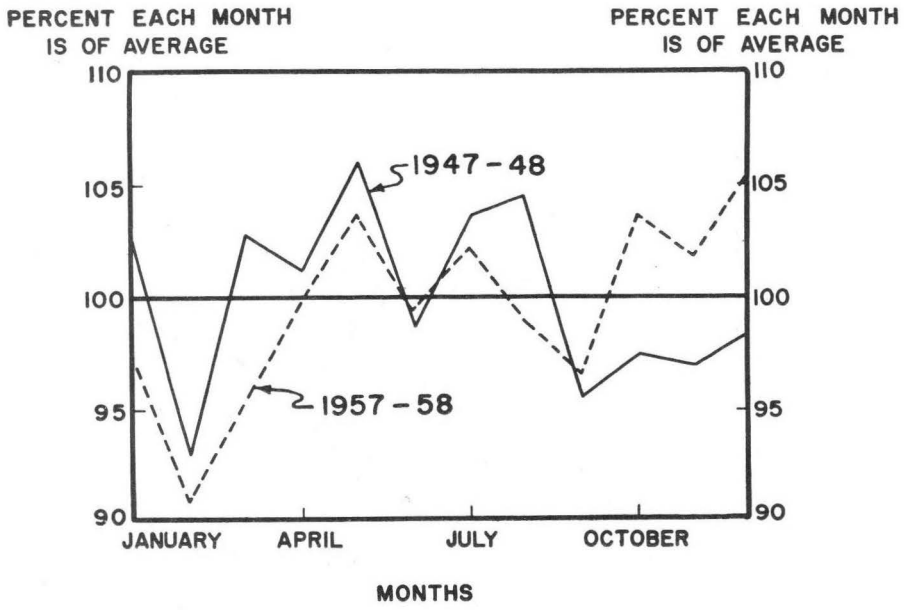
FIGURE 1. Changes in annual milk production, numbers of cows, and average daily yield per cow, Oahu, 1948–58 (1948=100)



Source: *Statistics of Hawaiian Agriculture*, Hawaii Cooperative Crop and Livestock Reporting Service Cooperating with United States Department of Agriculture, annual. Figure 1 based on following data:

Year	Annual milk production (1,000 quarts)	Average number of cows	Average daily yield per cow (quarts)
1948	24,371	6,884	9.7
1949	25,031	6,720	10.2
1950	28,936	7,300	10.9
1951	31,938	8,480	10.3
1952	31,037	8,680	9.8
1953	33,872	9,154	10.5
1954	34,060	8,940	10.4
1955	35,642	9,060	10.8
1956	39,497	9,670	11.2
1957	43,295	10,270	11.5
1958	46,407	10,880	11.9

FIGURE 2. Seasonal pattern of milk production, Oahu, 1947–48 and 1957–58



Source: *Statistics of Hawaiian Agriculture.* **Figure 2 based on following data:**

Month	Average monthly milk production 1947–48 (1,000 quarts)	1957–58 (1,000 quarts)
January	2,124	3,524
February	1,921	3,286
March	2,127	3,623
April	2,097	3,615
May	2,195	3,750
June	2,043	3,598
July	2,145	3,698
August	2,164	3,582
September	1,977	3,490
October	2,018	3,750
November	2,007	3,680
December	2,037	3,818

The opening of schools in the fall after the long summer vacation causes a sudden rise in demand for fresh milk. Within recent years (as school milk has assumed greater importance) local milk distributors have encouraged island dairy farmers to plan for a relatively high rate of production between October and January to meet this situation. Milk production is held at a level some 10 percent above "normal demand" to meet sudden changes of the kind outlined and also fluctuations in the number of tourists on the island.

The fairly steady flow of milk to the Honolulu market throughout the year is achieved by such management practices as arranging for a steady succession of "fresh cows," shipping in cows from the mainland United States, heavier or lighter culling of relatively light milkers, heavier or lighter feeding, and early or late "drying-off" of cows.

Figure 2 compares the seasonal pattern of output in the two 2-year periods, 1947–48 and 1957–58. It shows the relatively small amount of fluctuation in output from month-to-month and the close similarity in the output patterns of the two periods. The main difference is the larger output in the fall of the later period, 1957–58, for a reason already explained.

Milk Consumption

It follows from the preceding comments about the recent increase in market milk production from Oahu dairies that demand for this commodity must have risen. Annual per capita consumption of fluid milk in the Honolulu metropolitan area is estimated to have risen from about 59 quarts in 1948 to about 94 quarts in 1958 (figure 3). Total annual civilian consumption of fresh milk and cream in that period is estimated to have risen by some 20 million quarts, from 22 million to 42 million quarts.

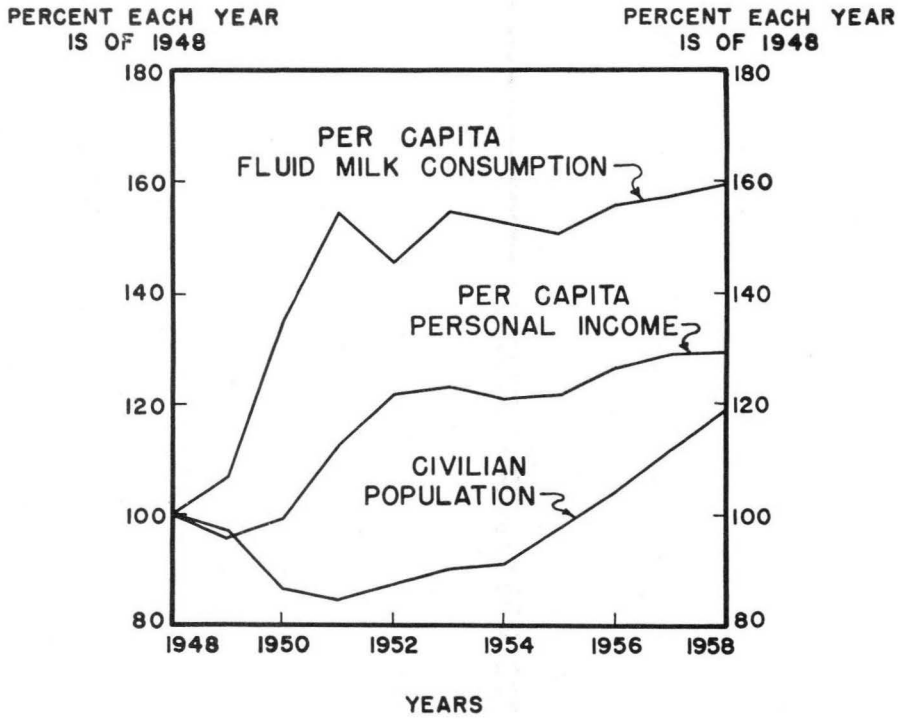
This upward trend in demand, which is in striking contrast to the downward trend in fresh milk consumption on the Mainland, probably resulted from several factors: a gradual rise in the amount of purchasing power in the hands of the consumer—per capita income was $1,411 in 1948 and $1,826 in 1958; a favorable relationship between milk and other food prices —during the 11-year period the price of milk went up by about 10 percent and the prices of other foods about 22 percent; growing importance of milk in school meals together with the habit of milk drinking which tends to follow from the school milk program; and changing eating habits of Hawaii's several racial groups. A factor with some bearing on the relatively low rate of fresh milk consumption in the years 1948 and 1949 was an inadequate fresh milk supply. Existing demand was not fully satisfied.

The rapid growth in Oahu's civilian population since around 1952 has also exerted an upward effect on demand for fresh milk. Between 1948 and 1951 the island's population had continued downward from its wartime peak. It fell from 371,600 in 1948 to 315,300 in 1951. Oahu's civilian population was up to 443,500 by 1958.

The per capita consumption of fresh milk in the Honolulu metropolitan area, at around 94 quarts in 1958, was still only about two-thirds the corresponding level for the mainland United States at 142 quarts. The relatively high price of milk sold in Honolulu (about 7 cents per quart above the average mainland price) together with the relatively small demand for fresh milk among older people of oriental descent, who are an important segment of the island's population, probably account for this situation.

Local milk distributors are hoping for an improvement in per capita consumption of milk through a long-term educational program which stresses the nutritional qualities of milk. It is mainly directed towards the younger people of the Islands.

FIGURE 3. Changes in civilian per capita fluid milk consumption, per capita personal income, and civilian population, Oahu, 1948–58 (1948=100)



Source: *Bureau of Health Statistics, Territory of Hawaii, as at July 1, 1959.
†*The Income of Hawaii* (Research Bulletin), Hawaii Employers Council, November 1953, p. 15, and later issues. Figure 3 based on data given below.
‡Based on relationship between civilian population and total quantity of milk consumed on Oahu adjusted for military consumption (estimated).

Year	Civilian population*	Annual per capita personal income†	Annual per capita fluid milk consumption‡
	Thousands	*Dollars*	*Quarts*
1948	371.6	1,411	59
1949	360.1	1,354	63
1950	320.7	1,403	80
1951	315.3	1,586	91
1952	325.8	1,721	86
1953	335.1	1,740	91
1954	339.1	1,704	90
1955	362.2	1,720	89
1956	386.7	1,787	92
1957	416.1	1,821	93
1958	443.5	1,826	94

Inputs

The recent rise in milk production led to changes in the quantity and composition of inputs or supplies used. A prominent feature of the island's dairying is its dependence on the Mainland for a large proportion of its inputs. Feed, cows, and equipment are largely imported.

This section of the report shows that with one important exception—dairy cows—the recent increase in Oahu milk production has largely come from more imported rather than more local inputs.

Freight: An indirect input, but one of major importance in local milk production, is freight on cows, feed, equipment, and other miscellaneous items shipped from Pacific Coast ports to Honolulu. Freight on such supplies currently accounts for about 3½ cents of the estimated difference of 6 cents in the cost of producing a quart of milk in the Honolulu and Los Angeles milksheds (17.3 cents per quart in Honolulu, 11.3 cents in Los Angeles).[3] Clearly, any change in ocean freight rates has an important effect on the cost of milk production in the Honolulu milkshed, its profitableness, and ultimately, the retail price of milk.

Changes which took place between 1948 and 1958 in freight rates on general merchandise (including dairy equipment), cows, hay, grain, and concentrate feed are given in table 2.

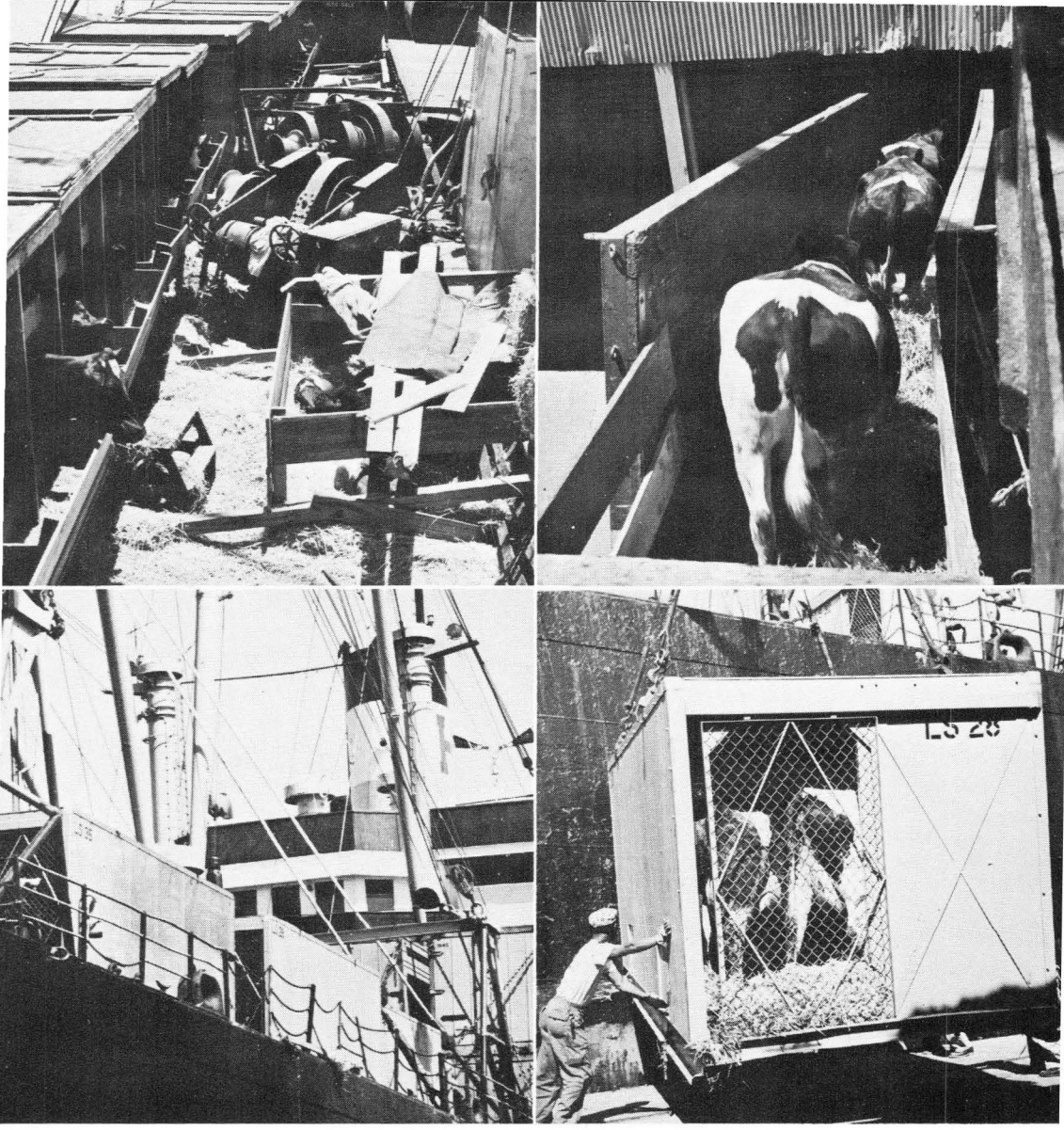
TABLE 2. Schedule of freight rates on general merchandise, cows, hay, grain, and concentrated feed, San Francisco to Honolulu, 1948–58

Year (changes in rates only are given)	General merchandise (40 cu. ft. or 2,000 lb.) *	Cows per head	Hay per ton	Grain, concentrated feed per ton
		Dollars		
1948 (Sept. 1)	13.60	58.00	16.50	13.00
1951 (Feb. 1)	15.00	64.00	18.10	14.30
1953 (Jan. 14)	16.12	68.80	19.45	15.37
1953 (March 1)	17.50	74.00	21.00	16.70
1955 (March 1)	18.55	78.44	22.26	17.70
1957 (Feb. 11)	20.31	85.90	24.38	19.36
1957 (July 15)	21.00	88.80	25.20	20.00
1958 (Jan. 20)	22.90	96.80	27.45	21.80

*Whichever is greater.
Source: Matson Navigation Company.

Ocean freight rates increased steadily. They rose on general merchandise from $13.60 to $22.90 per 40 cubic feet—an increase of 68 percent. Similar increases occurred in the rates for cows from $58.00 to $96.80 per head, hay from $16.50 to $27.45 per ton, and grain and concentrate feed from $13.00 to $21.80 per ton.

[3] *Ibid.*, p. 11.



Dairy cattle shipped from Pacific Coast ports to Honolulu travel in two kinds of containers—portable and nonportable. The two upper photographs, left to right, show cattle in nonportable pens and walking off the ship, respectively. The two lower photographs, left to right, show cattle in portable pens or containers awaiting removal from the ship and in process of being lowered to the quay.

The rates given in table 2 do not include such items as insurance, dock handling, stock tending, or tolls. Some idea of the importance of these items is given by the following figures which together represent the current cost (March, 1959) of shipping a cow from the Mainland to Honolulu:

Freight	$102.00
Insurance	4.00
Stock tending	3.50
Haulage	3.00
Wharfage fee	.70
Total shipping charges	$113.20

The cost of selected feeds and dairy replacements in Los Angeles and Honolulu in March, 1959, was as follows:

Item	*Unit*	*Los Angeles*	*Honolulu*	*Difference*
"Fresh" cow	1	$335–$345	$525–$550	About $190
Soybean meal	1 ton	$76	$115	$39
Cottonseed	1 ton	70	105	35
Mill run	1 ton	51	80	29
Alfalfa hay	1 ton	34	71	37

These figures give some indication of the relatively large freight bill facing island dairy farmers. It is alleged that part of the high cost of freight is attributable to "monopoly" profits earned by the shipping company which carries the bulk of such cargo.

Freight is not only an important—though indirect—item of cost in Oahu dairying, but a factor leading to uncertainty in the quantity and quality of feed supplies for dairy cattle. Cows in "small" dairies, in particular, tend to live "from ship to ship." Even large dairies able to build up reserves of dairy feed are frequently inconvenienced by late or nonarrival of expected supplies. Strikes or threats of strikes by local longshoremen are another hazard. For instance, the last major dock strike in 1949 lasting 6 months resulted in the slaughter of some dairy cattle because feed supplies were inadequate.

Feed: Feed is about 46 percent of annual production costs and about 60 percent of annual cash expenses in Oahu dairying. An important feature of this island's dairying is the relatively small area of land available for grazing or forage crops. Some 10,700 acres are available for about 10,800 cows. Much of this land is too dry and rocky for use as pasture. Only about 2,500 acres is used for grazing and forage crops in the immediate vicinity of the dairies; another 6,000 acres is pasture land often some distance from the dairies and frequently used for dry cows and the rearing of some dairy replacements.

The relative scarcity of locally produced feed for dairy cows was clearly brought out in the 1956 survey, mentioned earlier, into the economics of grass use on Oahu. That study revealed as many as 21 out of the 57 commercial dairies did not feed grass in any significant amounts. It showed that only 10 of the 36 dairies which did feed grass in any noticeable amounts

relied on pasturing as the main source. Cut grass was found to be relatively more important than pasturing. The amount of cut grass fed (mainly coarse grasses such as Napier grass with a high fibre and low nutrient content) varied considerably from 9–12 pounds to 50–54 pounds daily per cow. Most dairies which cut grass fed between 23 and 44 pounds daily per cow.[4]

The other major local feed is pineapple bran, a by-product of the local pineapple industry. It is the dried skin and core of processed pineapples. Typical dairy rations include between 10 and 18 pounds of pineapple bran. It is useful in providing bulk for the ruminant dairy animal.

The supply of pineapple bran which, of course, depends on the quantity of pineapples processed has not within recent years kept pace with demand for the bran. About 23,000 tons of pineapple bran were used by Oahu dairies in 1958—roughly 15 percent more than in 1948. The numbers of cows fed bran increased by about 60 percent in that period. This growing disparity between local feed supplies (grass, pineapple bran, and some sugar strip cane) and total feed requirements of cows in Oahu dairies has resulted in an increased dependence on imported supplies, mostly from the mainland United States. It is, perhaps, appropriate to mention at this point that local dairymen are fully aware of this situation. Currently, experiments are under way at the Hawaii Agricultural Experiment Station to determine the usefulness of dried pineapple leaves and tops as a dairy feed; alfalfa is also being tried as a forage crop.

Table 3 shows changes in the quantities of dairy feed shipped into Honolulu from foreign and mainland United States sources between 1948 and

[4] *Grass for Oahu Dairies, Op. cit.*, pp. 21–26.

TABLE 3. Dairy feed from foreign countries and mainland United States used by Oahu dairies, 1948–58

Year	Feed grains*	Mill feeds†	Mixed feeds‡	High protein feeds§	Total
	Tons	*Tons*	*Tons*	*Tons*	*Tons*
1948	2,354	2,630	598	10,743	16,325
1949	3,060	3,667	1,066	10,694	18,487
1950	4,071	4,295	1,164	11,903	21,433
1951	3,998	4,812	1,754	12,230	22,794
1952	3,462	3,695	2,534	13,090	22,781
1953	3,196	4,354	2,516	16,174	26,240
1954	3,033	4,322	1,550	14,547	23,452
1955	2,764	4,250	1,521	15,967	24,502
1956	2,996	4,494	1,449	18,797	27,736
1957	2,840	4,944	1,549	21,174	30,507
1958	2,586	5,048	1,700	23,978	33,312

*Barley, oats.
†Mill run, wheat meal, "other mill feeds."
‡Proprietary feeds.
§Alfalfa meal, copra meal, cottonseed meal, soybean meal.
Source: *Statistics of Hawaiian Agriculture*, annual.

1958. These quantities are not precise and involve a certain amount of error. They are indicative, however, of the general trend and are considered sufficiently accurate for our immediate purposes. Total yearly feed imports more than doubled during this 11-year period—from 16,000 tons to 33,000 tons. It will be recalled that Oahu's annual milk production almost doubled between 1948 and 1958.

The relationship between numbers of cows and imported feed supplies in 1948 and 1958 shows the extent to which cows on Oahu dairies have become more dependent on overseas supplies. About 1.9 tons of imported feed were consumed per cow in 1948; the corresponding figure for 1958 was about 3.2 tons per cow. The higher rate of feeding imported supplies is also directly connected with the rise which occurred in average daily yield per cow, up from 9.7 quarts to 11.9 quarts between 1948 and 1958. The economy of feeding dairy cows relatively large amounts of grain and concentrate feed is examined later in this report.

Cows: Most cows used in Oahu dairying are shipped from the Mainland (table 4). The relative scarcity and consequent high cost of agricultural land on the island of Oahu has severely restricted any large-scale rearing of dairy replacements on that island. (Shortly, however, dairy cattle may be reared intensively on feedlots recently opened on Oahu.) A growing proportion of such cattle (about 1 in 4, at present) are, however, coming from neighboring islands of the Hawaiian chain where land is more plentiful and relatively cheap. Increasingly, calves of suitable quality (bred by artificial insemination from proven sires) are being shipped from Oahu by barge to the islands of Maui, Hawaii, and Kauai where rangeland is available. They return as mature animals shortly before calving time.

TABLE 4. Inshipment of cows from the mainland United States and Neighbor Islands to Oahu, 1948–58

Year	U. S. Mainland	Neighbor Islands	Total inshipments	Average number of cows on Oahu
1948	1,147	327	1,474	6,884
1949	1,703	318	2,021	6,720
1950	2,148	267	2,415	7,300
1951	1,870	250	2,120	8,480
1952	1,216	441	1,657	8,680
1953	1,103	344	1,447	9,154
1954	1,414	479	1,893	8,940
1955	1,757	726	2,483	9,060
1956	2,117	506	2,623	9,670
1957	2,647	792	3,439	10,270
1958	2,080	696	2,776	10,880

Source: *Honolulu Unloads*, annual summaries.

Until recently, local rearing of dairy heifers was poorly organized. Cattle tended to be raised in small lots, their ancestry unknown, and their up-

bringing uncertain. The wide disparity between prices of local and imported heifers, which in recent years has averaged around $200, to the disadvantage of locally bred cattle, reflects doubts which dairy farmers have held about such animals. Some are undoubtedly good, but until recently buying local cattle as replacements was considered to be a "risky" business. Now, attempts are being made on a more scientific and businesslike basis to provide local farmers with suitable heifers, with proper attention being given to stock selection and feeding.

Shipments of cows from the Mainland and Neighbor Islands to Oahu are given in table 4 for the period 1948–58.

The relatively short milking life of cows on Oahu dairies is suggested by data given in table 4. It appears to be around 3 to 3½ years. This implies a rate of turnover in dairy cattle significantly above that for mainland dairies where the comparable figure is between 5 to 6 years. The relatively short milking life of cows in Oahu dairies is an important factor contributing to the high cost of producing milk in the Honolulu area. It is attributed to two main factors: a high culling rate required by the need to maintain high production per cow, and inclusion in shipments from the Mainland of a proportion of poor quality cows (variously estimated by local dairy farmers at between 15 and 20 percent).

Labor: Until recently, little reliable information has been available relating to numbers of dairy workers. The following data are based on recent inquiries among dairy farmers, trade unions, and the Territorial Labor Department.

The number of hired dairy workers was estimated in December, 1958, at about 300, at 400 in 1954, and about 450 in 1948. Productivity per worker has sharply risen in the last 11 years as milk production has almost doubled while the number of workers has fallen by some 150, or one-third. The number of cows per man has risen from about 15 in 1948 to about 36 in 1958. Milk produced per man, on an annual basis, has risen from about 54,000 quarts in 1948 to about 155,000 quarts in 1958—nearly triple the earlier level.

Three factors largely account for this big change in the productivity of dairy workers: higher yielding cows; the mechanization of the milking process—from the cow to the bottling plant; and the growth of a strong trade union among dairy workers, aided by strong urban pressures on rural wages. The widespread adoption of the pipeline system of milking (first introduced on the island around 1952) has taken the "lift" out of milking by enabling the dairy worker to give all his attention to milking cows rather than first milking and then carrying the liquid to the receiving tank. Under that system, once the milk was cooled and poured into 10-gallon cans it had to be carried to the refrigeration room. The pipeline system channels milk directly from cow to cooler or cold wall tank. Then it flows into a can, as before, or is pumped into a tank truck for shipment to the bottling plant.

Collective bargaining between dairy workers and proprietors has been a notable feature of Oahu dairying since 1954. The union contract has stimu-

lated dairy farmers to make the best possible use of labor. The entry of the union has not led to any restrictive practices designed to "spread out the work" which is in contrast to conditions known to exist in other industries. Increased output per man has been actively encouraged by the union concerned. The strong influence of the booming Honolulu metropolitan area on wage levels of hired agricultural workers has coincided with union pressure on farmers to increase wages and provide "fringe benefits." Skilled dairy workers, handling relatively large numbers of cows and expensive equipment, are at a premium.

Other Inputs: A variety of items are included under this heading: land (already mentioned under the heading of "feed"), fuel, electricity, maintenance and repair of buildings and equipment, veterinary services and medicines, trucks, tractors, grass cutting and harvesting equipment, and artificial insemination. Few data are available about recent changes in these inputs. It seems clear, however, from the nature of the recent increase in milk output and in the numbers of cows kept on Oahu dairies that a substantial increase has occurred in almost all these inputs (except land).

An indication of the present extent of some of these miscellaneous inputs is provided by data collected during the 1958 cost survey. Total annual costs incurred by Oahu dairies for the various items are estimated as follows:

Rent and interest on owned land	$200,000
Fuel, repairs, and local freight	$450,000
Depreciation on buildings and equipment	$293,000
Utilities, dairy supplies, veterinary services, etc.	$772,000

Investment in durable factors of production (excluding cows) which give a succession of services of one kind or another over a period of years is estimated as follows:

Land	$1,077,000
Buildings and improvements	$1,000,000
Dairy equipment	$ 576,000
Trucks, tractors, and automobiles	$ 413,000

Milk Marketing in Honolulu

The local market for milk is similar in its most important respects to many city milk markets on the Mainland. Prices paid for and the quantity of milk supplied by dairy farmers are not determined by the free play of those forces conveniently termed supply and demand. Instead, the two major milk distributors who control the bulk of fresh milk supplies in Honolulu enter into contracts with local dairies, the terms of which specify daily quantities to be delivered to the distributors and the procedure for pricing "surplus" milk. The market, in other words, is allocated among individual dairies on the basis of "quotas."

This device is an accepted way of allocating a market, on a local and an international level, for many important agricultural commodities besides

milk—such as wheat, cotton, tobacco, and sugar. Local conditions favor quota schemes. Production is concentrated in a relatively small, isolated area. Marketing and production conditions are similar for most dairies, and both farmers and milk distributors tend to gain from such arrangements.

In Honolulu the quota system has been adopted as an equitable means of sharing the market by distributors (insuring them some measure of production control—a matter of importance in the "pocket market" of Honolulu) and dairy farmers (insuring them a share of the market without the risk of "cutthroat competition"). An important factor encouraging the adoption of such a quota system is the low price elasticity of demand for fluid milk.[5] Roughly, this means that a relatively small increase in the supply of milk leads to a more than proportionate fall in milk prices and a lower total revenue from milk sales; or, conversely, that a relatively small rise in the price of milk does not lead to any significant change in the amount purchased and thus, total revenue increases.

Features common to the quota system used by the two major milk distributors in Honolulu are examined first, then the varying features.

Both quota systems feature the "classified price" plan which provides different prices to be paid for milk according to use and the "base and surplus" plan under which each dairy farmer has a basic quota. Any "surplus" milk marketed in excess of the individual quota is usually paid for at a lower "Class 2 price"—a device which penalizes those who produce much above their quota. Class 1 prices are only paid for that portion of milk deliveries sold as fresh milk and cream.

The price paid for "surplus" milk is based on the price of milk used for manufacturing purposes (mainly for butter, cheese, and dried milk) on the Mainland, with an allowance for freight from San Francisco to Honolulu. As market-grade milk competes directly with manufacturing grade milk when used for products for which the lower grade milk is available, this arrangement is understandable. Local "surplus" milk, in effect, replaces mainland butterfat and nonfat milk solids for such products as ice cream, cottage cheese, and yogurt.

Most dairies have a daily quota based on average daily output during the latter half of 1954. As demand for fresh milk has risen (see figure 3) in recent years, quotas have been issued to new dairies. Few of the older established dairies have had their original quotas increased since 1954. However, quotas are transferable from one farmer to another. The consent of the distributor concerned is needed for such a transaction to take place. Currently, the price involved for a daily quota of one can of milk (85 pounds) is between $1,250 and $1,500. Distributors deplore the fact that money is paid for the transfer of quotas and banks refuse to accept the rights which a

[5]In his comprehensive study of the structure of demand for milk products on the U. S. mainland, Rojko estimated the retail price elasticity of fluid milk at −0.3. This means that a 1 percent rise in price, other things being equal, leads to a drop in amount purchased of 0.3 percent, and vice versa. Anthony S. Rojko, *The Demand and Price Structure for Dairy Products,* Technical Bulletin No. 1168, U. S. Department of Agriculture, 1957, p. 62.

quota entails as collateral for a loan. Nevertheless, it has long been recognized that a share of a market has some value. A trader often calls it "good will" and expects to receive payment for this "invisible" item when his business is sold. Similarly, dairy farmers attach a relatively high value to their quota, for without it they would for all practical purposes have nowhere to sell their milk. Extra income from an additional quota is often obtained at little extra production expense, as available facilities are often adequate to handle more cows. The high value placed on extra quotas is largely explained by this relationship between marginal or extra costs and returns.

Both major distributors agree to buy all the milk delivered by their suppliers but require them to supply no other buyer. Milk supplied is accepted only if it meets certain stringent conditions relating to quality (fresh, sweet, uncontaminated, raw, and free from off-flavors). Deliveries are checked at regular intervals for butterfat and nonfat solids contents, contamination, and other qualities. Dairies are required to deliver a minimum quantity daily. If deliveries are consistently below quota the distributor has the right to reduce the quota after a certain specified time and the right to decide whether to cancel the unfilled quota or transfer it to another dairy.

The major difference between the two quota schemes in Honolulu relates to the system of payment for milk. One plan provides a base price for Class 1 sales of milk of 3.5 percent butterfat which "in no event shall be less than the prevailing blended price for milk of like composition by the other major distributor. . . ." The base price is paid for all quota milk delivered and accepted. The quota, under this scheme, is a minimum guarantee, as farmers under contract are expected to supply about 10 percent above their daily quota to provide the distributor with some leeway in meeting daily changes in demand for fresh milk. The farmer is encouraged to deliver milk with a close to "3.5 percent natural butterfat as possible." If the daily average butterfat test for any month is below 3.5 percent natural butterfat, the supplier is penalized by a drop in the base price of just over ½ cent a quart for each 0.1 percent that the butterfat content is below the stipulated minimum. Some compensation is given, however, if the average butterfat content exceeds that minimum, based on the current monthly average for "San Francisco 93 score butter market price quotation per pound, plus freight per pound from San Francisco to Honolulu."

Surplus milk, paid for at Class 2 prices, is not necessarily milk delivered above daily quotas. It is milk in excess of the sum of quotas *and* in excess of total sales of fresh milk and cream. If monthly sales of fresh milk and cream are greater than the total monthly quotas, the excess is prorated to all dairies which delivered above quota—on the basis of these quotas. Surplus milk for the individual dairy then becomes any excess over the "minimum" quota plus a share, if any, in "above quota" sales of fresh milk and cream.

The Class 2 prices for surplus milk, under this plan, are based on the prices of butterfat (taken as equivalent to the price of 93 score butter) and of nonfat solids, in San Francisco, plus freight.[6]

The second quota arrangement does not offer a "minimum" quota. The total of individual quotas may sometimes be above or below total monthly sales at Class 1 prices. If such sales are below the total of individual quotas in any month, say only 95 percent, then the farmer receives a Class 1 price only for a similar proportion of his monthly quota (unless some fail to supply all their quota).[7]

Farmers supplying milk under this second plan receive a "blend price" for milk used for Class 1 purposes. Their contract states that "Class 1 milk means Grade AA and Grade A fluid milk which is sold to the public at retail, wholesale, or under contract; also cream, skim milk, buttermilk, cottage cheese, chocolate milk, half and half, strawberry milk, yogurt, and any other milk products also sold to the public (milk products being so classified under regulations of the Board of Health as distinguished from manufactured products)." The price paid for Class 1 milk—the blend price—is determined by a complex formula which takes account of the quantities used and prices received for different uses, the cost of processing and marketing. Surplus milk, any milk not sold at Class 1 prices, is bought on its butterfat and nonfat solids contents at a rate equal to the San Francisco wholesale price of these commodities, plus freight to Honolulu.

Average prices paid to farmers under the two quota plans tend to be similar. The relevant data for 1958 are as follows:

Milk of 3.5 percent corrected butterfat content per quart

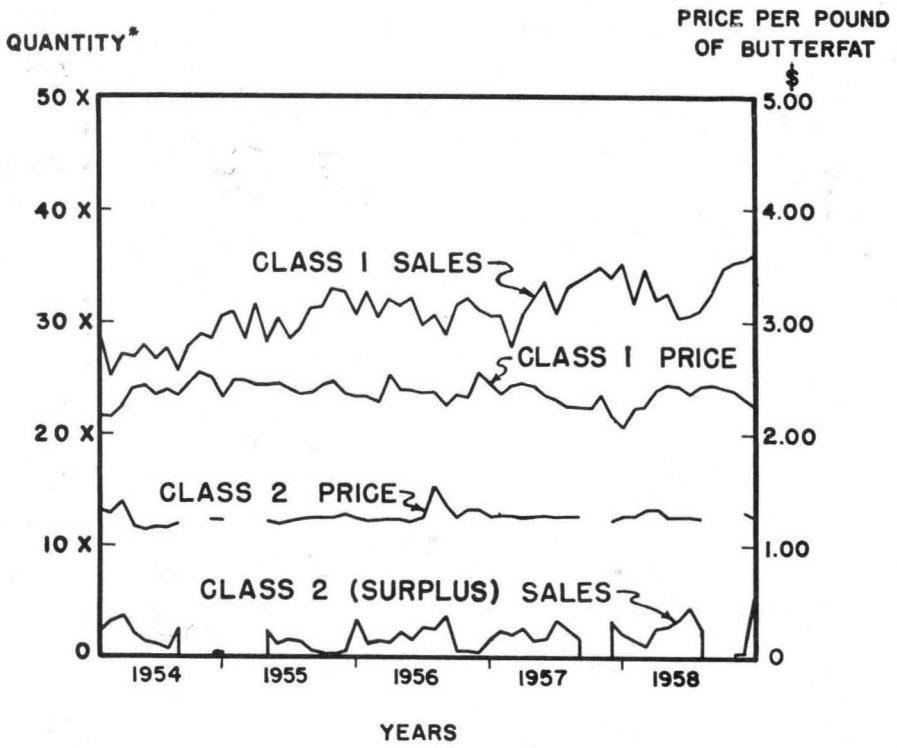
	Class 1 (*cents*)	*Class 2* (*cents*)
Plan A	17.90	9.23
Plan B	17.73	9.59

[6]The following figures relating to the calculation of the value of "surplus" milk are given for illustrative purposes: cost of 93 score butter in San Francisco—61.00 cents per pound, freight from San Francisco to Honolulu—2.72 cents per pound; cost of skim milk in San Francisco—18.00 cents per pound, freight from San Francisco to Honolulu—2.74 cents per pound. One quart of milk is assumed to contain 3.5 percent of butterfat and 8.6 percent of nonfat solids and to weigh 2.15 pounds; that is, each quart contains 0.075 pound of butterfat and 0.185 pound of nonfat solids. Multiplying the respective quantities and prices together—0.075 (B.F.) times 63.72 cents, and 0.185 (S.N.F.) times 20.74 cents, we arrive at the total value of a quart of "surplus" milk—8.616 cents.

[7]The proportions of the total individual quotas sold at Class 1 prices in 1958 were as follows:

	Percent		*Percent*
January	105.0	July	92.7
February	103.5	August	95.0
March	104.7	September	101.0
April	99.8	October	104.8
May	99.9	November	109.6
June	97.0	December	96.1

FIGURE 4. Supplies and prices of Class I and Class 2 milk (butterfat basis), a major Honolulu milk distributor, 1954–58



Source: A major Honolulu milk distributor.
***For commercial reasons, coded to avoid disclosure.**

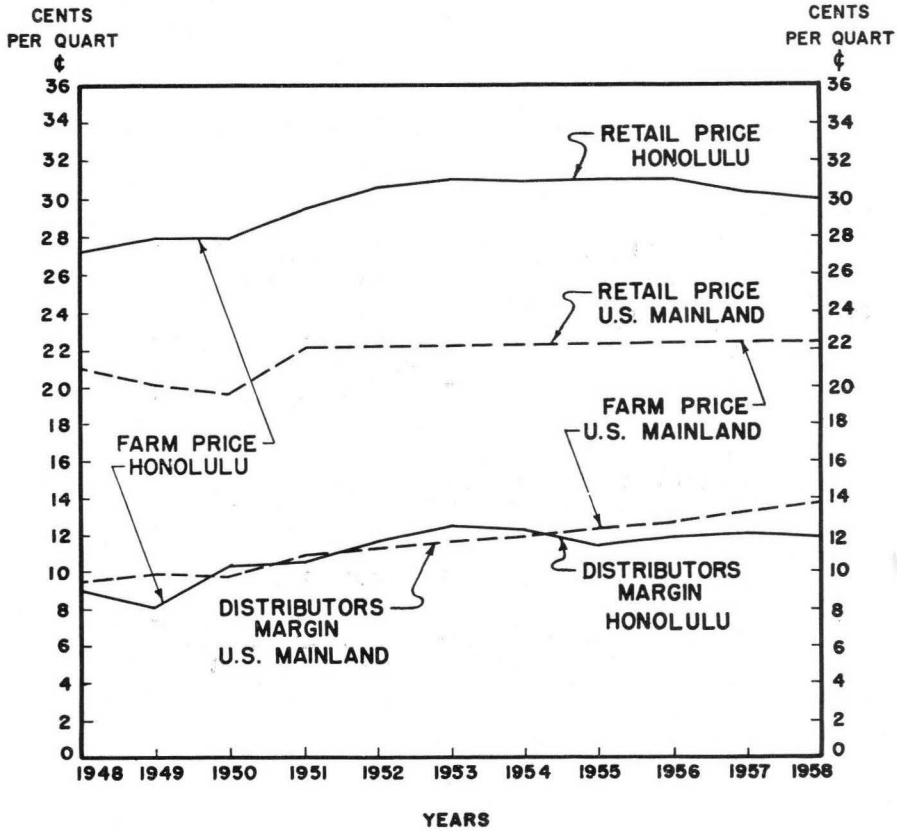
Some indication of the relative importance of "surplus" milk in the Honolulu market is given in figure 4. It usually amounts to between 3 and 8 percent of total monthly deliveries although it has been as much as 12 percent.

Retail Price and Distributive Margin

An important finding of the 1958 survey of the cost of producing market milk in the Honolulu milkshed was that "the higher cost of milk in Honolulu relative to Los Angeles and other mainland cities is largely attributable to the difference in production costs, rather than in costs of distribution."[8] This finding is further substantiated by data given in table 5 and figure 5 relating to retail prices and prices paid to the dairy farmer for market milk in the mainland United States and in the Honolulu area, during the 11-year period from 1948 to 1958.

[8] *Cost of Producing Market Milk on Oahu, op. cit.*, p. 12.

FIGURE 5. Average retail and farm milk prices, Honolulu and the U. S. Mainland, 1948–58



Source: U. S. Mainland—*The Dairy Situation,* Agricultural Marketing Service, USDA, February 1959, table 17, p. 28.
Honolulu—local milk distributors.

Table 5 shows local milk prices at the farm and retail level, while figure 5 compares these local data with comparable figures for the United States mainland. The average farm price for milk between 1948 and 1958 was about 18.75 cents per quart, varying from 17.74 cents in 1950 to 19.84 cents per quart a year earlier. The average farm price was about 62 percent of the average retail price of milk in Hawaii for the 11-year period, varying from 60 percent (in 1953, 1957, and 1958) to 71 percent (in 1949). The local distributors' margin, averaging around 11.00 cents per quart in the 11-year period under review, varied from 8.16 cents (in 1949) to 12.49 cents (in 1953) per quart. Figure 5 shows that the distributors' margins for the two selected areas were very similar. It also shows that the farm price of milk in the Honolulu area, between 1948 and 1958, was about 8 cents per

quart above the corresponding mainland price. Expressed in another way: in that period dairy farmers in the Honolulu area received about 62 percent of the retail price while mainland dairy farmers received about 48 percent.

Causes of the high cost of producing milk in the Honolulu milkshed are examined later in this report, together with possible ways of lowering costs.

TABLE 5. Average farm price and average home-delivered retail price of market milk, per quart, Honolulu, 1948–58

Year	Farm price	Retail price	Distributors'* margin	Farm price as a percentage of retail price
	Cents per quart	*Cents per quart*	*Cents per quart*	*Percent*
1948	18.25	27.33	9.08	67
1949	19.84	28.00	8.16	71
1950	17.74	28.00	10.26	63
1951	18.99	29.50	10.51	64
1952	18.94	30.58	11.64	62
1953	18.51	31.00	12.49	60
1954	18.76	31.00	12.24	61
1955	19.53	31.00	11.47	63
1956	19.08	31.00	11.92	62
1957	18.20	30.25	12.05	60
1958	18.09	30.00	11.91	60

*Difference between retail price and farm price.
Source: Honolulu milk distributors.

The Profitableness of Oahu Dairying

It is not possible to give a detailed account of recent changes in the profitableness of Oahu dairying, only general trends. In contrast to conditions on the Mainland where cost studies of dairy enterprises have been carried out for several decades, it is only within the last few years that similar studies have been started in Hawaii.

Table 6 gives some indication of the trend in profits from the island's dairying in the recent period (1948–1958) of expansion. It shows the relationship between the price of milk and the cost of a typical dairy ration, on a per quart basis. The average margin between these two quantities for the 11-year period was about 10½ cents per quart, varying annually from 9 cents to 12 cents per quart. Both feed and milk prices are shown to have been fairly stable during this period.

Output of milk from Oahu dairies almost doubled between 1948 and 1958. More output and a steady milk-feed price ratio suggest that Oahu dairy farmers as a whole received a favorable rate of profit during the 11-year period. Another indication that dairy farming has been relatively profitable is the increase in the number of Oahu dairies from 39 in 1948 to 60 in 1958. Honey attracts bees!

TABLE 6. Average farm price of milk and average feed cost, per quart, Oahu, 1948–58

Year	Average farm price	Average feed cost*	Margin
	Cents per quart	*Cents per quart*	*Cents per quart*
1948	18.25	8.62	9.63
1949	19.84	7.80	12.04
1950	17.74	7.46	10.28
1951	18.99	8.39	10.60
1952	18.94	9.86	9.08
1953	18.51	8.15	10.36
1954	18.76	7.88	10.88
1955	19.53	7.90	11.63
1956	19.08	7.70	11.38
1957	18.20	7.73	10.47
1958	18.09	7.90	10.19

*Calculated for a typical dairy ration on the assumption that efficiency in feeding remained unchanged in the 11-year period.

It is relevant, of course, to know what happened to other major production costs. Monthly wages of dairy workers increased from around $200 in 1948 to about $285 in 1958. It has already been pointed out, however, that the number of dairy workers was reduced from 450 to 300 in this 11-year period. Higher yields per cow have led to further reductions in labor cost per unit of output. Thus, it seems probable that labor costs per unit which were calculated at 3 cents per quart in the 1958 cost survey have slightly declined over the past 11 years.

On the other hand the cost of shipping supplies from the Mainland (see table 2) and the cost of dairy replacements have risen considerably. Prices of cows landed in Honolulu apparently fluctuated considerably between 1948 and 1958. There are no accurate records of prices paid for imported cows. Inquiries from cattle importers indicate that between 1954 and 1956 cows cost about $440 per head, about $485 in 1957, and about $550 in 1958. Comparable prices around 1948–50 were in the range $375–$400 per head.

The general movement of dairies from the close vicinity of Honolulu to more rural areas should be mentioned as a factor with some effect on the profitableness of Oahu dairying. Apart from dislocation caused by such a movement on the routine of dairying, frequently it has resulted in high capital expenditure for the purchase of land, new buildings, and equipment. This has tended to lower the rate of return on capital invested by the farmer in his dairy as, in most instances, the quantity of milk sold has remained unchanged.

A SUMMARY OF THE FINDINGS OF THE 1958 COST SURVEY OF 42 OAHU DAIRIES

The 1958 survey revealed that the average cost of producing a quart of milk in the 12-month period ending September 30, 1958, on 42 out of the 57 commercial dairies on Oahu was 17.31 cents. A wide variation existed in

average cost per quart among the 42 dairies. The relevant data are summarized in table 7. The table shows that three dairies had an average cost of only between 14.25 cents and 15.25 cents per quart while at the other extreme two dairies had corresponding costs of more than 20.25 cents. Roughly, three-fifths of the dairies had average costs of between 16.26 cents and 18.25 cents per quart and about two-thirds of total milk sales were produced in this cost range. Six dairies had an average cost greater than 18.25 cents per quart; they produced slightly more than 10 percent of total milk sales. Ten had relatively low average costs of less than 16.26 cents per quart; they contributed about one-fifth of total sales.

TABLE 7. Distribution of dairies and milk sales, by average cost per quart, 42 dairies, Oahu, 1957–58

Average cost per quart	Number of herds	Proportion of:	
		Herds	Milk sales
Cents		*Percent*	*Percent*
14.25–15.25	3	7.1	3.0
15.26–16.25	7	16.7	17.2
16.26–17.25	11	26.2	29.0
17.26–18.25	15	35.7	39.7
18.26–20.25	4	9.5	9.2
Over 20.25	2	4.8	1.9
Total	42	100.0	100.0

The average price received for milk in the selected 12-month period amounted to just under 18 cents per quart (17.96 cents)—leaving the dairy farmer an average net income of 0.65 cent per quart. The distribution of average price received per quart and the proportion of total sales at the various price levels are shown in table 8. The pattern of this table closely

TABLE 8. Distribution of dairies and milk sales, by average price per quart, 42 dairies, Oahu, 1957–58

Average price per quart	Number of herds	Proportion of:	
		Herds	Milk sales
Cents		*Percent*	*Percent*
16.50–17.00	8	19.0	10.9
17.01–17.50	7	16.7	11.2
17.51–18.00	7	16.7	21.7
18.01–18.50	11	26.2	25.5
18.51–19.00	4	9.5	18.0
19.01–19.50	3	7.1	5.7
19.51–20.00	2	4.8	7.0
Total	42	100.0	100.0

follows that of the previous table. Thus, eight dairies received an average price of only between 16.50 cents and 17.00 cents per quart while two received between 19.51 cents and 20.00 cents per quart. The largest group (11) had a corresponding price of between 18.01 cents and 18.50 cents while two groups of seven dairies had average prices of between 17.01 and 17.50 cents and 17.51 and 18.00 cents per quart, respectively. The remaining seven dairies had an average price of between 18.51 and 19.00 cents (4) and 19.01 and 19.50 cents (3) per quart.

TABLE 9. Distribution of dairies by average net income per quart, 42 dairies, Oahu, 1957–58

Average net income per quart	Distribution of herds	
Cents	*Number*	*Percent*
MINUS (—)		
4.50–2.50	2	9.5
2.49–1.50	2	
1.49–0.50	5	19.0
0.49–0.00	3	
		(28.5)
PLUS (+)		
0.01–0.50	5	23.8
0.51–1.00	5	
1.01–1.50	6	26.3
1.51–2.00	5	
2.01–2.50	5	11.9
Over 2.50	4	9.5
Total	42	100.0

It follows from these widely differing data relating to average costs and prices received that net income per quart varied considerably, too. The relevant data summarized in table 9 confirm this. Thus, 12 out of the 42 dairies in the 1958 survey incurred losses while 9 made more than 2 cents per quart. To complete the picture, 10 had a net income ranging from 0.01 cent to 1.00 cent per quart and 11 had a corresponding return of from 1.01 cents to 2.00 cents per quart.

Table 10 gives some details of the average cost of various inputs used in producing a quart of milk and in maintaining a dairy cow for 12 months. The most important items were feed—7.89 cents per quart (46 percent of the total cost); labor at 3.08 cents per quart (18 percent of total cost); and net stock expense (the net cost of the dairy herd's services in converting feed into milk) at 1.66 cents per quart (9.6 percent of total costs). Variations in these three cost items, roughly 75 percent of total costs, are shown

TABLE 10. Average annual cost of producing market milk, per cow and per quart, 42 dairies, Oahu, 1957–58

Item	Production costs		Proportion of total cost
	Per cow	Per quart	
	Dollars	*Cents*	*Percent*
Feed	331	7.89	45.6
Labor	129	3.08	17.8
Net stock expense*	70	1.66	9.6
Rent, interest	57	1.36	7.9
Freight, fuel, repairs	42	1.00	5.8
Depreciation: buildings and equipment	27	.63	3.6
Taxes, insurance	24	.58	3.3
Miscellaneous (utilities, dairy supplies, veterinary services, etc.)	47	1.11	6.4
Total	727	17.31	100.0

*The net cost of the dairy herd's services in converting feed into milk. This item includes: depreciation on cows, any losses sustained on the sale of culled animals or from deaths in the herd. A small amount of credit for calves and manure was normally deducted to arrive at a "net stock expense" figure.

later in this report to account for a large part of differences in net income per cow and per quart between the various dairies.

Investment

Average total investment per dairy and per cow are shown in table 11. The valuation of the different items of investment was based on the depreciated value of cows, buildings, etc. If the basis of valuation were to be changed to current replacement cost, the figures presented in table 11 would need to be increased substantially.

Table 11 shows that average total investment per herd and per cow amounted to $108,051 and $642, respectively. Cows were the most important

TABLE 11. Average total investment per herd and per cow, 42 dairies, Oahu, 1957–58

Item	Average total investment		Proportion of total investment
	Per herd	Per cow	
	Dollars	*Dollars*	*Percent*
Cows	57,810	344	53.6
Land	16,621	99	15.4
Buildings, improvements	15,533	92	14.3
Dairy equipment	9,011	53	8.3
Trucks, tractors, autos	6,401	38	5.9
Feed	2,675	16	2.5
Total	108,051	642	100.0

item of investment at an average amount per herd of $57,810 or 53.6 percent of total investment. Other important items were (on a per herd basis) land at $16,621; buildings and improvements at $15,533; dairy equipment at $9,011; and tractors, autos, and hauling equipment at $6,401.

Investment in an individual dairy depends on a number of factors including: the length of occupancy of the dairy (newcomers have the heaviest investment per cow); the number of cows; the area of land owned; and the age structure of equipment. Table 12 summarizes the investment picture per herd and per cow on the sample of 42 dairies.

TABLE 12. Distribution of dairies by total investment per dairy and per cow, 42 dairies, Oahu, 1957–58

Total investment per dairy	Number of dairies	Total investment per cow	Number of dairies
Dollars		*Dollars*	
40,000 or less	5	400 or less	3
40,001– 60,000	8	401– 500	4
60,001– 80,000	3	501– 600	6
80,001–100,000	9	601– 700	8
100,001–150,000	5	701– 800	5
150,001–200,000	6	801– 900	6
200,001–250,000	3	901–1,000	3
Over 250,000	3	Over 1,000	7
Total	42	Total	42

AN ANALYSIS OF FACTORS INFLUENCING THE PROFITABLENESS OF MILK PRODUCTION ON OAHU IN 1957–58

One of the most striking features of the 1958 dairy survey was the relatively wide range in cost, price received, and net income per unit of output. The chief causes of these differences are now examined.

While attention is focused on factors influencing profitableness of individual dairies, some comment is justified about the general level of earnings from dairy farming. This level is primarily influenced by the ratio between prices received for milk and prices paid for feed, cows, labor, and other inputs used to produce milk. Closely associated with this cost-price ratio is the supply-demand relationship for milk and milk products.

The individual farmer tends to have little control over any of these factors influencing the general level of earnings. Scope for using business acumen and farming talents largely resides in the management of the dairy herd. It is that aspect of dairying which is discussed in the remainder of this report.

Quite clearly, net earnings of Oahu dairies would have been higher in any year if the farm price of milk had been higher and the cost of feed and

labor had not changed. It seems certain, however, that existing differences in net income per unit between the various dairies would have persisted. Surely, it is in the interests of those with relatively poor results to find out how those doing better achieve their success.

The following analysis examines, in turn, the impact on net income of production per cow, economy in using the three major inputs of milk production—feed, labor, and net stock expense—and, price received for milk.

Production per Cow

It appears to be generally accepted among dairy farmers that "good cows pay more." A recent publication supports this contention.[9] It shows that in 1956–57 the "average" cow in the United States produced 6,100 pounds of milk and "netted" for its owner $31. On the other hand the "average" cow whose owner belonged to the Dairy Herd Improvement Association (periodically recording milk production and thus systematically improving quality of the herd) netted about 2½ times as much—to be precise, $76. Heavier yielding herds did even better. Those averaging 12,000 pounds per cow made an average net income of $111 per cow. The same publication shows that relatively high production per cow tends to lower unit costs—not necessarily of feed—but of labor and "fixed costs."

The relationship between annual production and net income per cow on 40 of the 42 dairies in the 1958 cost survey is shown in figure 6 (the two dairies excluded had heavy cattle losses in 1957–58). Milk from these dairies has been converted to a 3.7 percent butterfat corrected basis in order to provide a fair means of comparison between herds with heavier yielding cows producing low butterfat milk and herds with lower yielding cows with relatively high butterfat milk. The price received by farmers for milk is closely related to its butterfat content so this adjustment needs little justification.

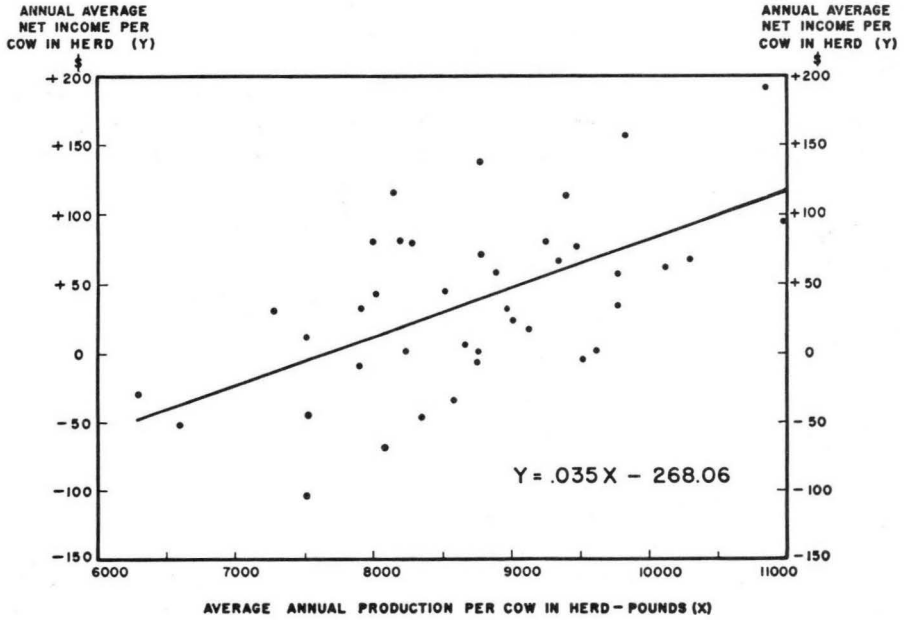
The solid line moving diagonally upwards from the bottom left-hand corner of figure 6 indicates the average relationship between net income and production per cow within the range of observed data. The equation of this line is: $Y = .035X - 268.06$.[10]

The scatter of dots around this regression line indicates the wide range which existed in these two quantities. Net income ranged from a loss of $105 per cow to a profit of $192 per cow; production per cow ranged from 6,300 pounds to 10,900 pounds. Average production per cow and average net income per cow for the group of dairies as a whole amounted to 8,726 pounds and $37, respectively. The scatter of dots in figure 6 also underlines the fact that production per cow only explains part of the wide variation in net income per cow between the dairies. Only about 31 percent of such differences are, in fact, explained in this way.

[9] *Agricultural Situation*. Agricultural Marketing Service, USDA, Vol. 43, No. 1, January, 1959, p. 10.

[10] Y = net income per cow; X = production in pounds per cow.

FIGURE 6. Relationship between average annual production per cow in herd and average annual net income per cow in herd, 40 dairies, Oahu, 1957–58



Nevertheless the relationship between net income and production per cow is statistically highly significant, and positive. Good cows do pay.

It follows that a considerable number of the dairies on Oahu could improve their financial position if more attention was given to improving the quality of their dairy cows. The recent adoption of a program for recording milk production among the island's dairy farmers is clearly an important step in this direction.

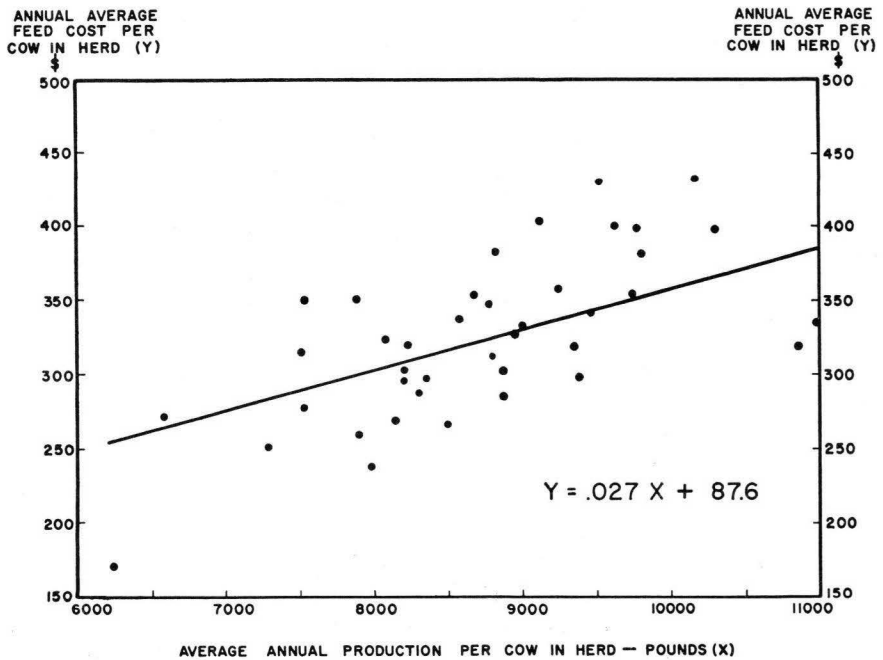
Heavy reliance on imported cows from the Mainland has not helped the local dairy farmer in his attempts to improve herd quality. The selection of good cows from among those imported is partly a matter of luck, as farmers draw lots as to who should have the first pick of the shipment, the second pick, and so on. While some dairies have established a reliable pattern of buying good quality cows from the Pacific Coast states—others, especially smaller dairies, have not been so fortunate. It is generally recognized that quality improvement requires careful selection of breeding stock and milk production recording. Only recently have serious attempts begun on Oahu's neighboring islands to provide dairy farmers in the Honolulu milkshed with good quality, locally produced dairy replacements. The saving in freight costs alone, from Pacific ports to Honolulu, should provide Oahu dairymen with sufficient incentive to support a local cattle raising program—provided adequate attention is given to providing the high quality stock needed for profitable dairying.

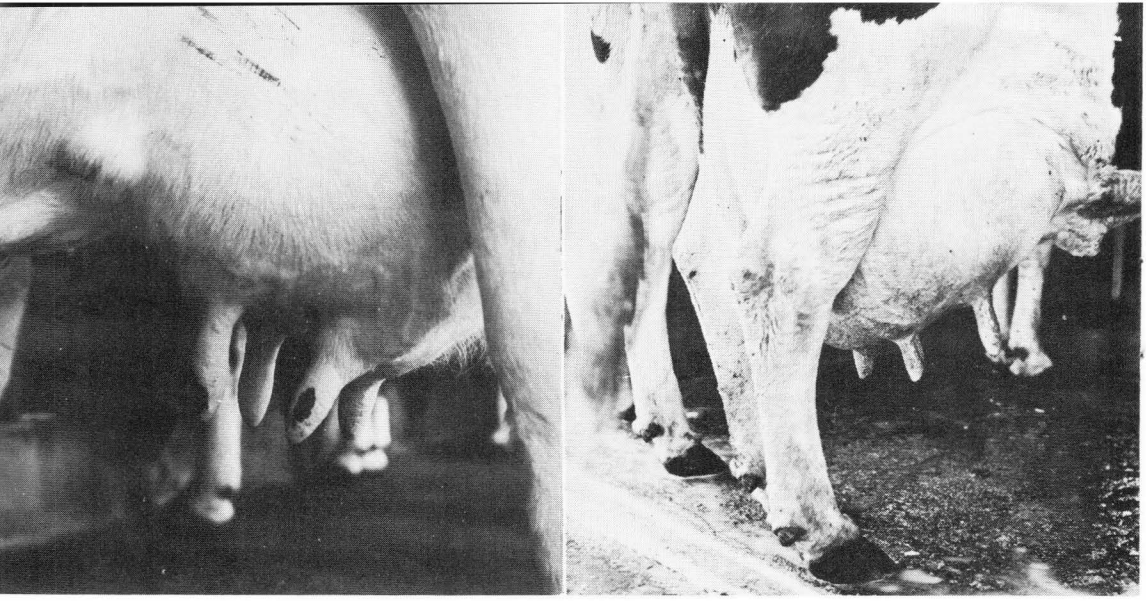
Feed

Economy in the use of feed—the most important cost item in milk production—has an important bearing on the net income from a dairy herd. Relatively low feed costs per unit of output are closely associated with such practices as careful buying of feeds to insure the cheapest possible ration (which at the same time provides the necessary nutrients), feeding dairy cows according to milk production and, as figure 6 suggests, culling low producing cows which may not be returning any net gain. The most profitable rate of feeding at any one time is, of course, intimately related to the ratio between milk and feed prices.

A wide range in feed costs per cow was found to exist on the 42 dairies surveyed in 1958. Figure 7 shows average annual feed costs per cow related to average annual production per cow for these dairies. As one would expect the average annual cost of feeding a cow rose with greater production per cow. It will be noticed, however, that there were wide differences in feed costs between dairies which had similar levels of production per cow. At the 8,000-pound level, for example, average feed costs per cow varied from $237 to $350. The corresponding range at the 9,000-pound level was from $280 to $404. These data appear to indicate considerable waste in feeding cows on some of the dairies perhaps by feeding too heavily, using needlessly costly feed, or feeding an unbalanced ration.

FIGURE 7. Relationship between average annual production per cow in herd and average annual feed costs per cow in herd, 40 dairies, Oahu, 1957–58





Where performance counts: Annual milk production from the cow on the right—15,000 pounds, on the left—8,000 pounds. Dairy profits are closely associated with milk production per cow (see figure 6).

The regression line ($Y = .027X + 87.6$) moving from the lower left-hand corner of figure 7 indicates the average relationship between feeding costs and production per cow on all except 2 of the 42 dairies. (The 2 dairies excluded had heavy cattle losses in 1957–58.)

Indirectly, figure 7 reveals the important relationship between feed costs per 100 pounds of milk and annual production per cow. As cows improve in quality and give more milk such costs tend to fall. The gain in feed economy comes from two main factors. First, the "overhead" cost of maintaining a cow is "spread" over more pounds of milk. Second, the better cow has a genetical structure which enables her to convert feed into milk more effectively than a lower producing cow. The average relationship between feed costs per 100 pounds of milk and production per cow as derived from the data given in figure 7 is given below, for selected levels of annual milk production:

Annual production per cow (pounds)	*Feed costs per 100 pounds of milk (dollars)*
6,000	4.16
8,000	3.85
10,000	3.58

These cost figures are only indicative of the gain to be expected from an improvement in the quality of a dairy herd.

Some evidence that dairy farmers differ considerably in their ability to select a relatively cheap ration for their cows is provided by data given in

table 13. These data were collected on a random basis from 10 of the 42 dairies in the survey and show the number of pounds of total digestive nutrients (T.D.N.) and number of pounds of digestible protein (D.P.) purchased with $10 by each of the dairies in February, 1959.[11] The data were compiled by analyzing the composition and cost of rations fed to dairy cows in that month and relating these costs to the two standard measures of the nutrient content of the ration.

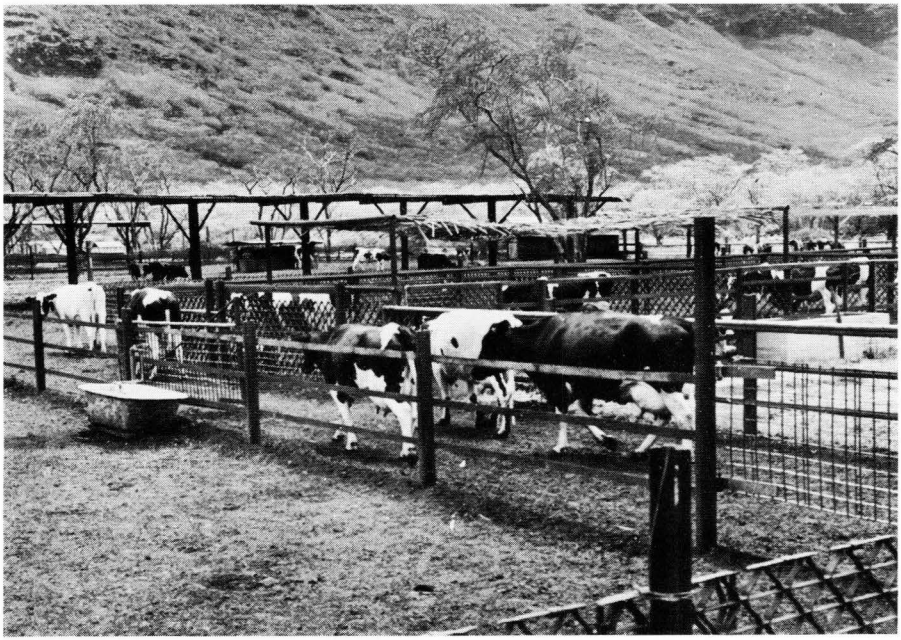
TABLE 13. Pounds of selected nutrients purchased with $10 by 10 dairies, Oahu, February, 1959

Farm No.	Pounds of total digestible nutrients	Pounds of digestible protein
1	176.3	30.6
2	183.5	48.0
3	184.0	37.1
4	185.6	32.5
5	188.0	38.9
6	191.2	37.2
7	204.5	35.7
8	206.7	37.6
9	219.5	52.7
10	225.1	40.9

Table 13 shows that a wide range existed in the amount of total digestible nutrients purchased with $10—from 176.3 pounds to 225.1 pounds, and in the amount of digestible protein from 30.6 pounds to 52.7 pounds. As good feeding practice requires balance between digestible nutrients and protein, these two components have to be considered together in determining whether a particular combination of feed is relatively cheap. Taking this into account, however, does not greatly lessen the meaning that can be derived from the data in table 13 that greater care in the selection of feed for dairy cows will tend to reduce feed costs (currently averaging about $350 per cow-year) on a significant number of Oahu dairies.

Another factor related to economy in feeding cows is the amount of attention given to insure that cows are, in fact, rationed according to yield. On the relatively large dairies on Oahu—with 100 and more in the milking herd—it is a difficult matter to give each individual cow the attention needed (and expected in smaller herds) to insure that feeding is related to production. It can be done by some system of marking the cows to indicate the extra quantity of "concentrates" to be fed. However, the practice usually adopted is to divide the cows into a number of "strings" of, say, 30 cows according to their production. The feeding is then based on the series of

[11] Total digestible nutrients is the net digestible portion of the feed available for growth and production. It is the common denominator used to express the energy content of carbohydrates, proteins, and fats.



A "string" of cows on a typical Oahu feedlot returning to their corral after being milked.

"strings"—the freshly calved and heavier yielding cows in the first string receiving most concentrates, right down to the last string, almost ready to leave the milking herd, which receives comparatively little. This system of dividing the milking herd into "strings" depends for its success on careful separation of cows into different groups according to production. Yet until very recently few dairies have consistently recorded milk yields. Thus, it seems very probable, and observations tend to confirm this, that cattle on some dairies are not grouped as well as they might be—with a resulting waste in the economy of converting feed into milk.

As a footnote to this important matter of economy in feeding, few of the 42 dairies surveyed kept a close check on the actual weight of feed given to individual cows. All kinds of containers were used to ladle the feed out to the animals, yet a quick check on the user's estimate of what such containers held, by weight, and the actual weight of the feed shows that there were considerable discrepancies between these two quantities.

There is thus considerable scope for improvement in the economy of feeding cows on Oahu dairies. It seems that more careful attention is needed in selecting rations which provide the necessary nutrients at the lowest possible cost, more care in feeding according to production, and wider adoption of milk recording to assist in this and to provide a sound basis for choosing good quality stock.

Labor

Economy in the use of labor, roughly one-fifth of the cost of milk production, is as important in its effect on profits in dairying as in most other farm and nonfarm enterprises. Yet, the evidence relating to labor costs collected during the 1958 survey suggests that labor is wastefully used on a significant proportion of Oahu dairies. Table 14 summarizes the relevant data showing the distribution of labor cost per cow-year and per quart.

TABLE 14. Labor costs per cow and per quart, 42 dairies, Oahu, 1957–58

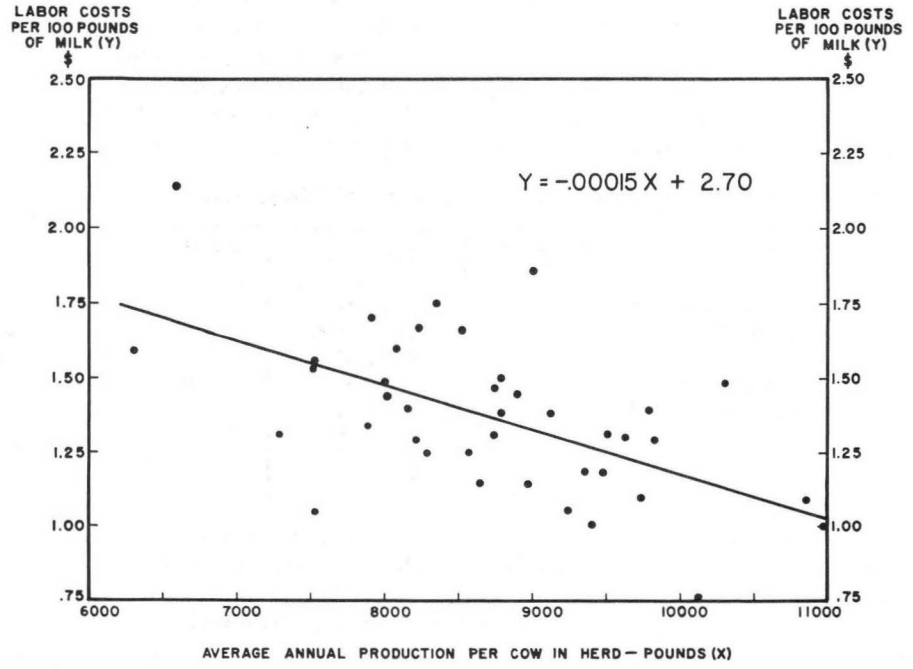
Per cow	Number of dairies	Per quart	Number of dairies
Dollars		*Cents*	
Under 100	6	Under 2.00	1
100–115	13	2.00–2.50	9
116–130	15	2.51–3.00	16
131–145	6	3.01–3.50	11
Over 145	3	Over 3.50	5
Total	42	Total	42

What accounts for such large differences in labor costs per cow or per quart on these dairies? Primarily, it would seem—labor management. A preliminary analysis of these cost data showed that there was little relationship between hours spent and production per cow. Nor was any significant relationship found to exist between size of herd and labor per cow—apart from the relatively small herds with around 50 cows. Labor input per cow in such herds tends to be relatively high and capital input somewhat lower than for larger herds. It may at first seem surprising that labor costs per cow do not decline as herd size increases, above 80–100 cows, as a result of "economies of scale." It seems, however, that "smaller" herds with 80–100 cows have a similar opportunity to use milking systems typical of larger herds, but with fewer milking units. The advantage of bigness is thus reduced.

An examination of the relationship between production per cow and labor costs per 100 pounds of milk shows that such costs fell from about $1.60 at the 7,500-pound level to about $1.05 at the 11,000-pound level. This relationship is shown in figure 8. The line drawn from the top left-hand corner of the figure towards the bottom right-hand corner expresses the average relationship between these two quantities. Lower costs per unit of output as production per cow increases result primarily from the spreading of a more or less fixed input of labor over an increasing number of pounds of milk.

Variation in labor costs is also, of course, directly related to the system of milking used. An appraisal of these various systems is not attempted here. Rather, an attempt is made to show that whichever system was adopted on a particular farm a considerable variation still existed in the efficiency with which that system was used. Some indication of these different rates of efficiency in labor use for similar milking systems is given in table 15. It shows

FIGURE 8. Relationship between average annual production per cow in herd and labor costs per 100 pounds of milk, 40 dairies, Oahu, 1957–58



the number of cows milked and the quantity of milk produced, per man-hour, on 18 Oahu dairies in February, 1959, with the bucket-type milking machine, the pipeline, and the parlor milking systems. It is advisable to use these two measures of comparison rather than, say, the number of cows milked per man-hour, in measuring performance standards. Low yielding cows are quickly milked yet leave little, if any, profit.

Table 15 shows that substantial differences existed in the amount of labor used with the three milking systems. Farmers using the pipeline system, for example, milked from 14 to 27 cows per man-hour (to the nearest whole number) and had an output varying from 218 pounds to 500 pounds of milk per man-hour. Similarly, those using the parlor system milked from 16 to 28 cows per man-hour and had a return of between 277 and 570 pounds of milk for that effort. The bucket system of milking used on the smaller dairies gave an output of between 175 pounds and 358 pounds of milk per man-hour; the number of cows milked during this time varied from 10 to 18.

Some part of these variations is undoubtedly caused by differences in the physical and mental capabilities of the milkers. Yet, experience from similar dairy surveys elsewhere indicates that a large part of these differences in labor use is explained by quality of labor management and amount of at-

TABLE 15. Performance rates per man-hour with 3 milking systems, 18 dairies, Oahu, February, 1959

Pipeline		Bucket		Parlor	
Cows milked*	Pounds of milk	Cows milked	Pounds of milk	Cows milked	Pounds of milk
Per man-hour		*Per man-hour*		*Per man-hour*	
14.4	218	10.0	175	15.8	277
16.1	310	10.7	268	20.0	375
17.1	285	11.6	216	25.0	440
17.2	340	17.7	275	28.0	570
18.0	380	18.0	375		
19.4	370	18.3	358		
23.3	500				
26.8	428				

*Solely as a matter of accuracy, cows milked per man-hour are not calculated to the nearest "whole cow."

tention given by the farmer to economies in labor. This involves such matters as the careful planning of a milking and feeding routine which requires the minimum amount of labor, the layout of corrals which reduces the distance between milking barn and corral to a minimum, and the use of the most suitable form of milking equipment for the size of herd maintained. Frequently, it is found that relatively small changes which reduce the time spent on routine chores result in a significant savings in labor costs over a period of several months.

It would appear from this analysis of labor costs on Oahu dairies that some improvement in labor management is possible on a significant number of dairies. A careful check on the current daily pattern of labor used by local dairy farmers is likely to confirm this statement.

Net Stock Expense

This item of expense is the net cost of a dairy herd's services in converting feed into milk. It includes depreciation on cows and any losses sustained on the sale of culled cattle or from deaths in the herd. A small amount of credit for calves and manure was normally deducted to arrive at a "net stock expense." This item represented about 10 percent of the total cost of milk production on Oahu dairies in 1957–58—the third most important cost item.

A wide variation was found to exist in this cost as with the other two major cost items—feed and labor. Table 16 summarizes the relevant data. It shows net stock expense on a per cow and a per quart basis. At one extreme, 15 dairies had a net stock expense of less than $50 per cow while the corresponding figure for 2 dairies at the other end of the scale was more than $150 per cow. Between these two extremes, 22 dairies had costs of between $50 and $100 per cow for this item while the remaining 3 had costs amounting to between $101 and $150 per cow. Table 16 also shows that

TABLE 16. Net stock expense per cow and per quart, 42 dairies, Oahu, 1957–58

Per cow	Number of dairies	Per quart	Number of dairies
Dollars		*Cents*	
Under 50	15	Under 1.00	8
50–75	11	1.00–1.50	10
76–100	11	1.51–2.00	11
101–150	3	2.01–2.50	6
Over 150	2	Over 2.50	7
Total	42	Total	42

a somewhat similar situation existed on a per quart basis. At the lower end of the scale, 8 dairies had less than 1 cent cost per quart for this item while at the upper end 7 had a net stock expense amounting to more than 2.50 cents per quart. Between these two extremes 21 dairies had expenses of between 1 and 2 cents per quart and the remaining 6 had corresponding expenses of between 2.01 and 2.50 cents per quart.

It seems very probable that a dairy farmer has considerably less opportunity to control the amount of net stock expense than either his feed or labor costs. Disease control is to some extent in the hands of the farmer, yet death or disease sometimes strike a dairy herd with little regard to the quality of the cattle or the excellence of the management. Several of the better Oahu dairies did, in fact, have their net income severely reduced in 1957–58 as a result of "some trouble with the cattle." Whatever means is adopted to reduce this expense it still tends to remain an unknown quantity with a potential threat to the income position of a particular dairy. In other words, it is one of the risks of dairy farming.

Attempts to reduce losses through death and disease are generally organized on a community basis. Good progress is currently being made in this direction in Hawaii. However, local dairymen have an opportunity to reduce the amount of net stock expense by more careful selection of dairy replacements, particularly those shipped from the Mainland. A significant proportion of imported cattle—variously estimated by Oahu dairymen at between 10 and 20 percent—suffer some damage in shipment. Sometimes it may lead only to a minor setback, but not always. Even if only 1 out of every 10 cows purchased has to be culled after only a short milking life, an expense of some $300 or more remains with the milking herd. Dairy farmers cannot afford to stand many losses of this kind.

Although locally reared cattle, shipped by barge from neighboring islands, are just as likely to be damaged en route to Honolulu as cattle shipped from the Mainland, they have one big factor in their favor.[12] The difference between their buying price (about $275–$300) and the selling price of culled cattle (about $200) is only about $75 to $100. Imported cows currently cost between $500–$550 per head and as culls sell at the same price as locally raised cows.

[12] Wendell Calhoun, *Marketing Hawaii's Beef Cattle,* Agricultural Marketing Service, USDA. (In press.)